Growth Comparison and Fecal Mineral Excretion of Inorganic and Organic Trace Mineral Supplementation in Swine

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Summary and Implications

Fecal Analysis, off-test weights, and ultrasonic measurements were used to determine the response of Bioplex™ trace minerals on the fecal mineral excretion (copper Cu, iron Fe, and zinc Zn) and growth and performance traits measured on live pigs (n=528). The use of Bioplex™ mineral supplementation on phase fed grow-finish pigs could potentially decrease the amount of heavy metal and nutrient excretion without impacting the overall performance of the animal. These organic mineral supplements can ultimately be fed to finishing swine without having a significant effect on percent lean (live or carcass), loin muscle area (LMA), backfat (BF10), average daily gain (ADG), or feed efficiency (FE). The use of Bioplex™ trace minerals has the potential to reduce the environmental impact of swine production without any loss of production efficiency to the producer. Future work in the use of Bioplex™ trace minerals and other mechanisms to reduce the environmental impact of swine production is warranted.

Introduction

Modern lean genetic lines of pigs require nutritionally dense diets to meet the requirements for lean tissue deposition (Schinckel and deLange, 1996; Thompson et al., 1996). Pigs have been fed highly concentrated diets formulated to typically provide an excess margin of nutrients to maximized performance. However, until recently producers have not been concerned with the levels of nutrients excreted. Today's, large-scale, commercial swine production systems, has given rise to many environmental concerns. Current intensive swine production systems have concentrated the volume of manure produced in geographical area, which can lead to accumulations often exceeding the crop nutrient requirements. Bioplexes™ can be utilized at a much lower concentration in the diet than inorganic minerals, without an impact on performance, while also decreasing the excess mineral excretion. Leeson (2003) has indicated that chelated trace mineral minerals (Bioplex™ Products) are at least 30% more bioavailable when compared to inorganic trace mineral salts when fed to broilers. Hence, current environmental concerns facing intensive pork production may be further investigated by determining the effects of enhanced bioavailability of trace minerals utilized in typical diets.

Materials and Methods

Two replications of 264 pigs (n=528) were used in a completely randomized design to investigate the effect of inorganic and organic mineral supplementation on the fecal mineral excretion (copper (Cu), iron (Fe), and zinc (Zn)), growth performance, and ultrasonically measured carcass characteristics of swine. Four dietary treatments were utilized and fed to segregated pens containing 10-12 pigs per pen (n=24) throughout the grow finish period. Treatment 1 (control) contained a common trace mineral supplement (Kent Feeds, Muscatine, IA), while treatments 2, 3, and 4 contained Alltech's Bioplex™ products at 100%, 75%, and 50% of the common trace mineral supplemented levels, respectively. Fecal samples were collected during each of the four diet phases. Off-test weights and ultrasonic tenth rib backfat (BF) and loin muscle area (LMA) measurements were collected on all pigs prior to harvest at a mean live weight of 118 kg.

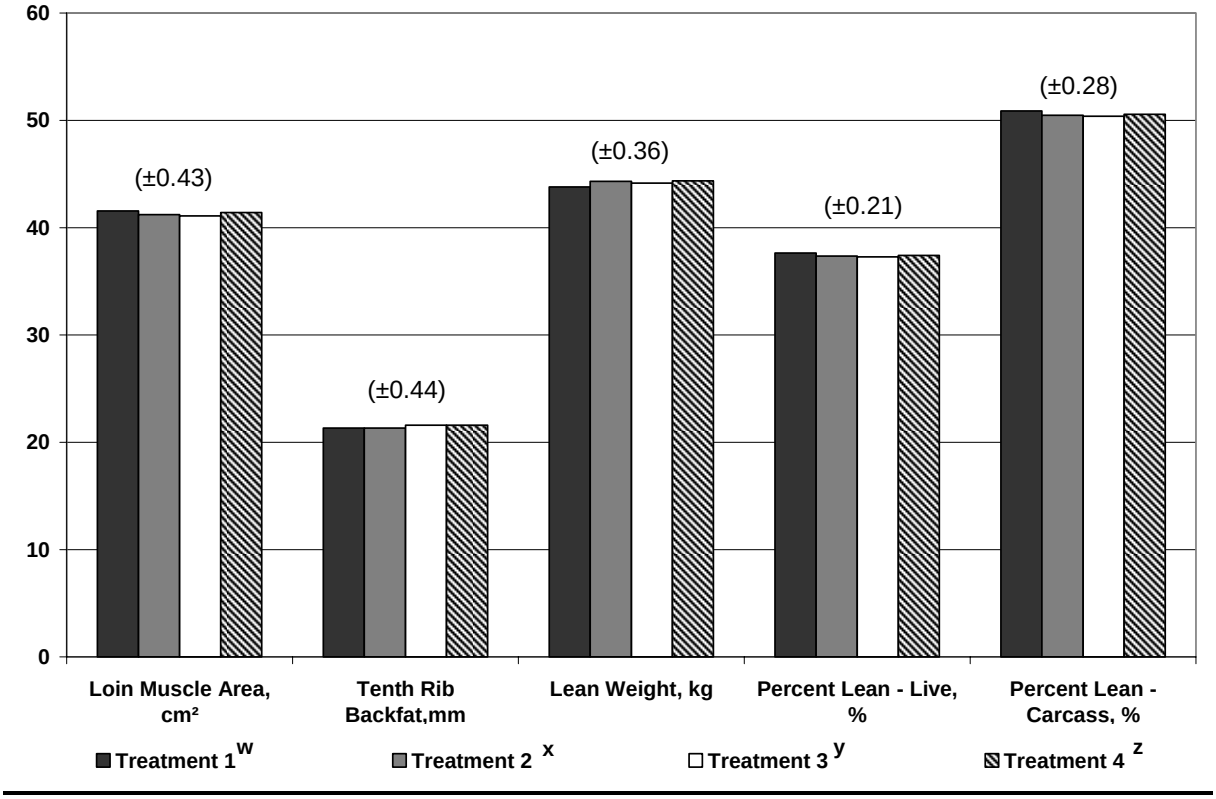
Average daily gain (ADG) and average daily lean growth on test (LGOT) were calculated from the data collected on the individuals. Pen feed intake was calculated by feed weigh-back to determine average daily feed intake (ADFI), feed efficiency (FE), and efficiency of lean gain (LE). Additionally percent lean, calculated on a live basis, (PLL), percent lean, calculated on a carcass basis, (PLC), and kilograms of lean (LW) were calculated from ultrasonic measurements using the NPPC formula (National Pork Producers Council, 2000). For the analysis of these data, a mixed linear model was utilized with fixed effects of replication, treatment, sex and the interaction of sex by treatment. Pen nested within treatment was included as a random effect for traits evaluated on an individual basis. Off test weight was included as a covariate in the analyses of ADG, LGOT, ADFI, FE, and LE. Treatment differences for excretion levels of copper (Cu), iron (Fe), zinc (Zn) were assessed by the use of a mixed model that included fixed effects of replication, treatment and sex. Feed consumption was included as a covariate in the model.

Results and Discussion

Pigs fed the control diet consumed less ($P<0.05$) feed per day than pigs fed the three experimental diets. No differences ($P>0.05$) among the treatment means for BF, LMA, ADG, LGOT, and LE (Refer to Figures 1 and 2). No differences ($P>0.05$) were observed in the overall carcass and performance traits, including treatment means for PLL, PLC, and LW (Figure 1). Replication and sex effects were

significant sources of variation for BF, LMA, ADG, LGOT, and ADFI. Fecal analysis revealed that the control diet excreted significantly higher ($P<0.05$) amounts of copper across all four diet phases (Figure 3). Collection during diet phase 3, for pigs fed gradient levels of Bioplex™ mineral , excreted less ($P<0.05$) copper than pigs fed treatment 2 (100% Alltech Bioplex™). No significant ($P>0.05$) difference between treatments 3 and 4 during the fourth diet phase collection for copper excretion levels (Figure 3). Iron was excreted significantly higher ($P<0.05$) by pigs fed the control diet during the first three phase collections. No differences ($P>0.05$) were observed in the fourth diet phase collection for iron excretion levels (Figure 4). Zinc was excreted at significantly lower ($P<0.05$) levels by pigs fed the lowest level of Bioplex™ supplementation across diet phase collections 2, 3, and 4 (Figure 5). Pigs fed the control diet excreted significantly higher ($P<0.05$) levels of zinc when compared to the experimental diets over the four collection phases (Figure 5). The lowest level of Bioplex™ appears to be the most advantageous, of the three experimental diets, in lowering the overall mineral excretion levels when compared to traditional trace mineral supplementation (control).

Figure 1. Least squares means (±SE) of carcass traits measured on grow-finish swine fed inorganic and gradient levels of organic mineral supplementation.



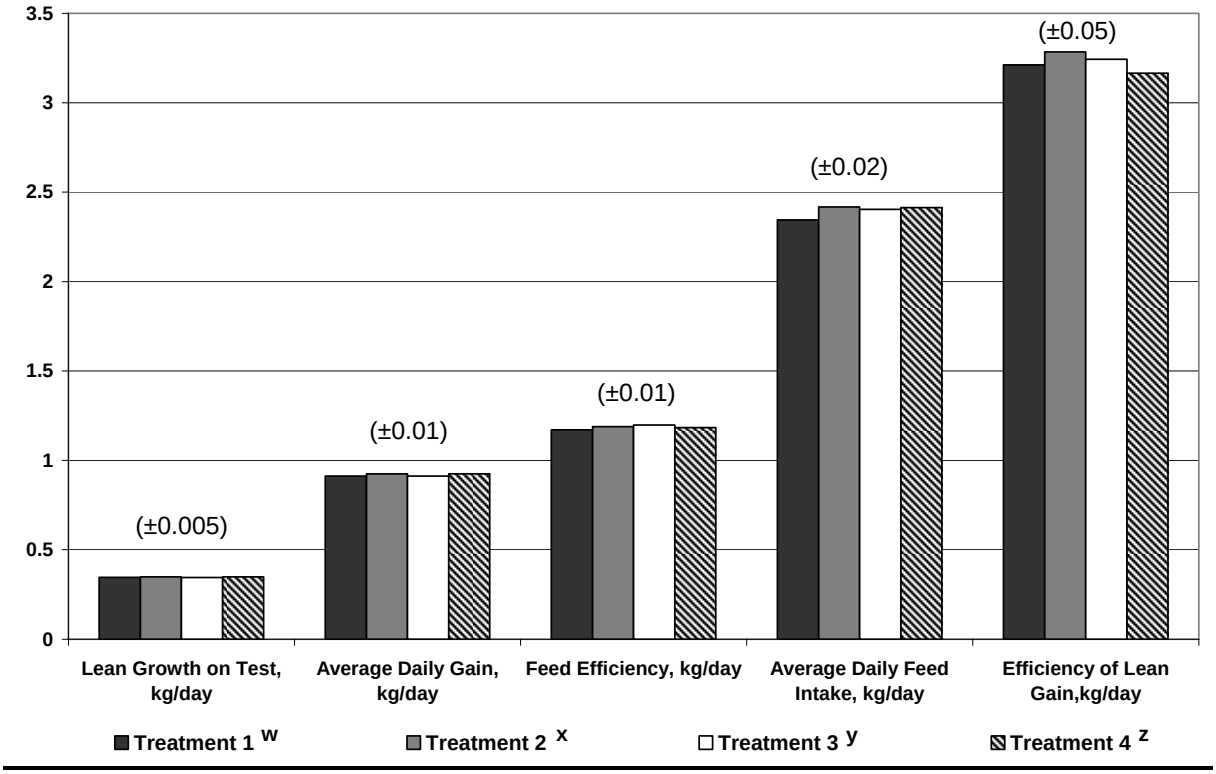
[w]Treatment 1- (control) Commercially available traditional trace mineral supplementation which met or exceeded NRC recommendations for each phase of grow finish swine (Kent Feeds, Muscatine, IA)

[x]Treatment 2-Trace mineral supplementation with the use of Alltech's Bioplexes at 100% of NRC recommended added levels.

[y]Treatment 3- Trace mineral supplementation with the use of Alltech's Bioplexes at 75% of NRC recommended added levels.

[z]Treatment 4- Trace mineral supplementation with the use of Alltech's Bioplexes at 50% of NRC recommended added levels.

Figure 2. . Least squares means (±SE) of performance and efficiency traits measured on grow-finish swine fed inorganic and gradient levels of organic mineral supplementation.



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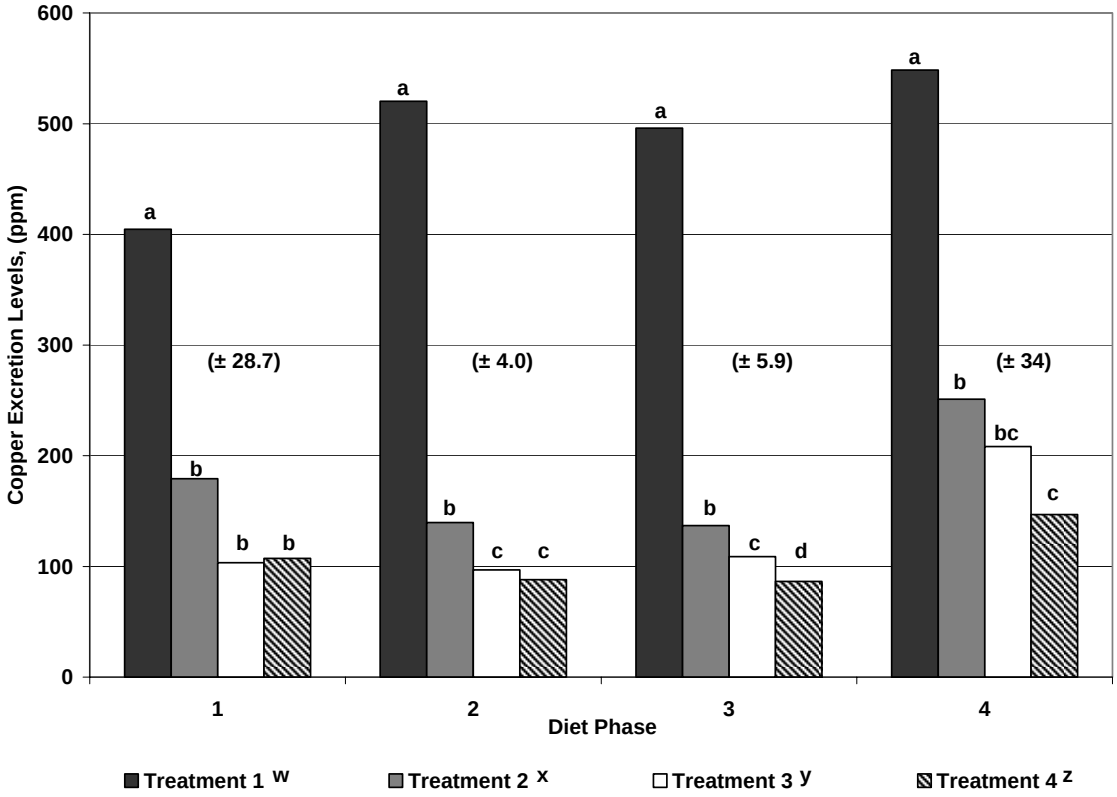
[z]Treatment 4- Trace mineral supplementation with the use of Alltech's Bioplexes at 50% of NRC recommended added levels

Figure 3. Least squares means (±SE) of copper excretion levels measured on grow-finish swine fed inorganic and gradient levels of organic mineral supplementation.



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[abcd]LS means within each diet phase with different letters are statistically different ($P < 0.05$).

Figure 4. Least squares means (±SE) of iron excretion levels measured on grow-finish swine fed inorganic and gradient levels of organic mineral supplementation.

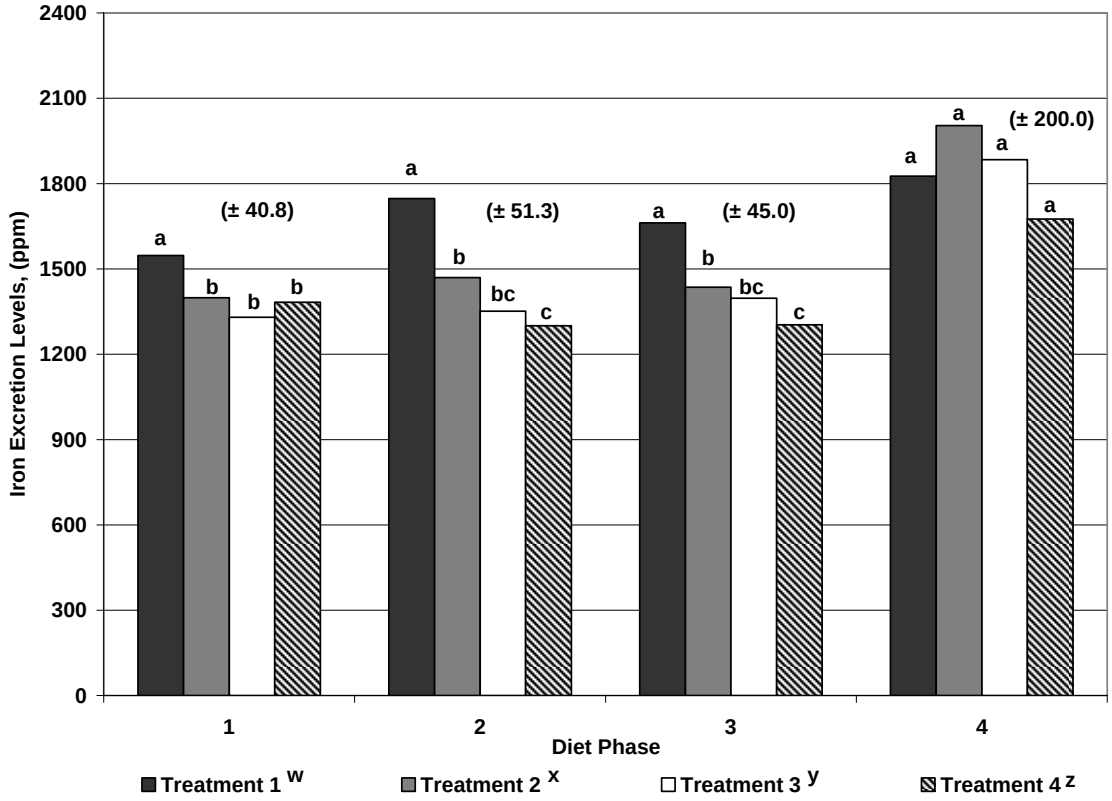

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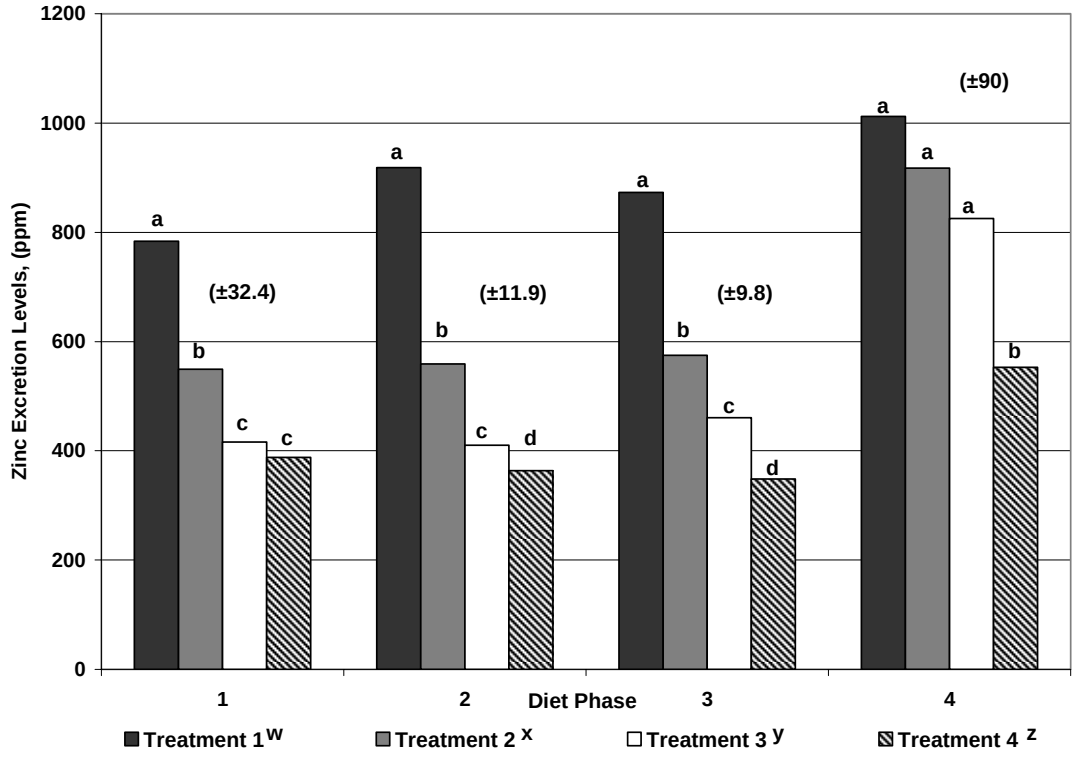
Figure 5. Least squares means (±SE) of zinc excretion levels measured on grow-finish swine fed inorganic and gradient levels of organic mineral supplementation.



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